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THE USE OF CHEMICALS IN THE FIELD OF FARM ANIMAL HEALTH (NUTRITION, ENTOMOLOGY, PATHOLOGY). AGRICULTURAL CHEMICALS TECHNOLOGY, NUMBER 7.

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DEVELOPED BY A NATIONAL TASK FORCE ON THE BASIS OF STATE STUDIES, THIS MODULE IS ONE OF A SERIES DESIGNED TO ASSIST TEACHERS IN PREPARING POST-SECONDARY STUDENTS FOR AGRICULTURAL CHEMICAL OCCUPATIONS. THE SPECIFIC OBJECTIVE OF THIS MODULE IS TO PREPARE TECHNICIANS IN THE FIELD OF THE USE OF CHEMICALS FOR ANIMAL HEALTH. SECTIONS INCLUDE -- (1) CHEMICALS FOR NUTRITION, INSECT CONTROL AND ERADICATION, AND PROTECTION AGAINST DISEASE FOR FARM ANIMALS, (2) TERMINOLOGY AND COMPUTATIONS, (3) NUTRITIONAL DEFICIENCY, PARASITIC INFESTATION, AND DISEASE RECOGNITION AND IDENTIFICATION, (4) CHEMICALS USEFUL FOR ANIMAL HEALTH, (5) CHEMICAL PRINCIPLES AND CONCEPTS, (6) SKILL IN USING CHEMICALS, AND (7) CHEMICAL HANDLING, TRANSFORTATION, STORAGE, AND APPLICATION. SUGGESTIONS FOR INTRODUCING THE MODULE ARE GIVEN. EACH SECTION INCLUDES RECOMMENDED SUBJECT MATTER, TEACHING-LEARNING ACTIVITIES, INSTRUCTIONAL AIDS, AND REFERENCES. THE MATERIAL IS DESIGNED FOR 24 HOURS OF CLASS INSTRUCTION, 36 HOURS OF LABORATORY EXPERIENCE, AND 80 HOURS OF OCCUPATIONAL EXPERIENCE. THE TEACHER SHOULD HAVE AGRICULTURAL CHEMICAL EXPERIENCE. STUDENTS SHOULD HAVE POST-HIGH SCHOOL STATUS, APTITUDE IN CHEMISTRY, AND AN OCCUPATIONAL GOAL IN THE INDUSTRY. THIS DOCUMENT IS AVAILABLE FOR A LIMITED PERIOD FOR $6.75 PER SET (VT 001 214 - 001 222) FROM THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION, THE OHIO STATE UNIVERSITY, 980 KINNEAR ROAD, COLUMBUS, OHIO 43212. (JM)

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THE USE OF CHEMICALS IN THE FIELD OF FARM ANIMAL HEALTH

(Nutrition, Entomology, Pathology)

AGRICULTURAL CHEMICALS TECHNOLOGY
No. 7

The Center for Research and Leadership Development

in Vocational and Technical Education

The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

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MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) James W. Hensel (Agency) The Center for Vocational and Technical Education

(Address) 980 Kinnear Road, Columbus, Ohio 43212

DATE: August 7, 1967

RE: (Author, Title, Publisher, Date) Module No. 7, "The Use of Chemicals in the Field of Farm Animal Health (Nutrition, Entomology, Pathology)," The Center for Vocational and Technical Education, December, 1965.

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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(3) Utilization of Material:
Appropriate School Setting Post High School
Type of Program Intensive, full-time, two-year, technician program
Occupational Focus Goal in the Agricultural Chemicals Industry
Geographic Adaptability Nationwide
Uses of Material Instructor course planning
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency Background in agricultural chemicals
Student Selection Criteria Post high school level, aptitude in chemistry, high school prerequisite, goal in the agricultural chemicals industry.
Time Allotment Estimated time listed in module. (P)

Supplemental Media --
Necessary x
Desirable
(Check Which)

Describe Suggested references given in module. (P)

Source (agency)
(address)

This publication is a portion of the course material written in Agricultural Chemicals Technology. To be understood fully, the complete set of materials should be considered in context. It is recommended that the following order be observed for a logical teaching sequence:

#1 - The Use of Chemicals as Fertilizers

#2 - The Use of Chemicals as Insecticides - Plants

#3 - The Use of Chemicals as Soil Additives

#4 - The Use of Chemicals as Fungicides, Bactericides and Nematocides

#5 - The Use of Chemicals to Control Field Rodents and Other Predators

#6 - The Use of Chemicals as Herbicides

#7 - The Use of Chemicals in the Field of Farm Animal Health (Nutrition, Entomology, Pathology)

#8 - The Use of Chemicals as Plant Regulators

TABLE OF CONTENTS

Suggestions for Introducing the Course 1

Competencies to be Developed

I. To develop an interest in and an appreciation and understanding of man's attempt, through the use of chemicals, to: (1) satisfy various nutritional requirements of farm animals for normal growth and reproduction: (2) control or eradicate insects and similar pests which attack farm animals: and (3) protect against disease or modify the effects of pathological agents which infest farm animals. 5

II. To develop the ability to use important terms, nomenclature, definitions, tables, charts, and guides which are used and also to develop the ability to perform important computations, conversions, calculations, and measurements which are commonly used by technical workers in the field of farm animal health. 12

III. To learn to recognize and identify: (1) Conditions essential for the prevention of nutritional deficiencies, parasitic infestations, and disease caused by pathogenic bacteria, fungi, and viruses in farm animals; and (2) Symptoms of stress commonly exhibited by farm animals which are the results of nutritional deficiencies, infestations of parasites, and diseases caused by pathogenic bacteria, fungi, and viruses. . 19

IV. To become knowledgeable at the technical level regarding various chemicals commonly used in the field of farm animal health. 23

V. To gain an understanding of the principles and concepts related to the use of chemicals in the field of farm animal health. 35

VI. To acquire and be able to practice the skills and abilities essential in using chemicals to maintain the health of farm animals. 39

VII. To acquire the skills needed to lawfully and safely handle, transport, store, and apply or administer chemicals used to maintain farm animal health. . . 44

THE USE OF CHEMICALS IN THE FIELD OF FARM ANIMAL HEALTH

(NUTRITION, ENTOMOLOGY, PATHOLOGY)

Major Teaching Objectives

To develop personal qualities and effective abilities needed for entry by technicians in occupations which have to do with the use of chemicals in the field of farm animal health.

Suggested Time Allotment

At School	24 hours	
Laboratory Experience	36 hours	
Total at School		60 hours
Occupational Experience		80 hours
Total for the Course		140 hours

Suggestions for Introducing the Course

The curriculum which has been developed for the program in "Agricultural Chemicals Technology" focuses primarily upon the uses made of chemicals in the plant science field. The main reason for using this approach in such a training program is because of the predominate use made of chemical resources in this field throughout the nation and also because of the greater number of occupational opportunities possible. However, it is recognized that animal science predominates in some sections of the nation and that in some areas perhaps livestock and poultry production are found exclusively. The emphasis given the plant science field in no way minimizes the importance of qualifying technical workers for service in occupational areas pertaining to animal science.

In locations where livestock production predominates, the instructor will need to modify the course offerings to fit the local or regional needs. Emphasis could easily be placed on the animal phases of the introductory courses outlined for each of the fields of pathology and entomology. No doubt it would be desirable to substitute a course in "Feeds and Feeding" for one of the plant science courses. Other changes may be desirable. (Parasitology, Introduction to Vet. Science, etc.)

At the outset of this unit, it is important to recognize the role played by professional personnel who devote their time to animal science. The place of the veterinarian and animal nutritionist is acknowledged in the animal field just as was the place of the entomologist, plant pathologist, and soil scientist in the plant science field. It is intended that technicians educated to engage in activities associated with animal health will do so with respect and due consideration given to others who also labor in the field.

The following suggested activities may help to introduce the study of farm animal health:

1. From information obtained from workers in industry, business, public service, and education, develop with the students a list of the skills, abilities, and understandings which agricultural chemical technicians need for employment in the fields of dairy, poultry, and livestock production. The list will include entries for each of the following subheadings:

   a. Man's use of chemicals to attempt to prevent or control disease, malnutrition, and insect and pest infestation of farm animals.

   b. Federal, state, and local laws, regulations, and controls pertaining to the sale and use of chemiaals in the field of farm animal health.

   c. The recognition and identification of:

      1) Conditions essential for the prevention of nutritional deficiency, insect and pest infestation, and disease.

      2) Symptoms of stress commonly encountered in farm animals which are the results of nutritional deficiency, disease and insect infestation.

   d. Various chemical resources available for use to prevent or control disease, malnutrition, and insect infestation of farm animals.

   e. Understandings, principles, and concepts related to the use of antibiotics and other agricultural chemicals in the field of farm animal health.

   f. Skills, abilities, and understanding of practices used in the field of animal health to prevent or control disease, malnutrition, and insect infestation.

   g. Important terms, definitions, nomenclature, tables, charts, and guides used and important computations, calculations, conversions, and measurements performed by technical workers in the field.

   h. The safe and effective handling and using of various chemicals in the field of farm animal health.

2. List groups of activities in which technical workers engage in the field of farm animal health. The list will include some of the following:

   a. Give leadership and direction to others--manage, supervise, direct, oversee, govern, program.

   b. Publicly show and encourage the adoption and use of goods and services--demonstrate, promote, sell, exhibit, display, market.

   c. Use physical, chemical, and biological principles and techniques to form new applications--invent, plan, design, originate, devise, create.

   d. Communicate ideas and information to others--illustrate, depict, diagram, design, layout, blueprint, portray.

   e. Make a verbal or written accounting to others--relate, report, notify, tell, account, inform, apprise, advise.

   f. Maintain and keep in operational repair--adjust, service, maintain, minor repair and replacement of parts.

   g. Determine why there has been success or failure--inspect, examine, survey, analyze, investigate, study, inquire, review, test.

   h. See if something works, try out, ascertain by experiment, compare for proof--test, prove, give a trial, verify.

   i. Operate and/or make proper application and use of in the field--operate, perform, adjust, manipulate, calibrate, control, adapt, hitch, regulate.

   j. Offer advice and expertness to others--advise, counsel, recommend, suggest, advocate, instruct, prescribe.

   k. Evaluate results, determine the value of and come to the conclusion--evaluate, assess, appraise, rate, estimate, value, judge, select.

   l. Plan a course of action--formulate, propose, decide on, recommend, specify, prescribe.

   m. Identify and recognize various elements of situations, conditions, and circumstances--become aware of, cognizant, alert to, analyze.

   n. Procure pertinent information relevant to particular situations, conditions, items, and circumstances--research, investigate, find out, study, obtain.

3. Develop a list of factors which tend to complicate the task of preventing or controlling disease, malnutrition, and insect infestation in farm animals through the use of chemicals. Included would be such items as:

   a. Resistance of some insects and pathogens to chemicals.

   b. Difficulty of accurately diagnosing symptoms of nutritional and disease stress.

   c. Expense of control programs.

   d. Ineffectiveness of some chemicals.

   e. Damage may be serious before control can be secured in many instances.

   f. Danger of drift and residues.

4. Determine with the students, the various kinds of chemicals that are available from local firms and agencies for use in the field of farm animal health.

   a. Insecticides

   b. Food Additives

   c. Antibiotics

   d. Nematocides

   e. Drugs

5. Present an animal health problem to the class, ask how it should be solved. Point out all of the factors which should be considered and the objective and subjective judgments which have to be made.

Competencies to be Developed

I. To develop an interest in and an appreciation and understanding of man's attempt, through the use of chemicals, to: (1) satisfy various nutritional requirements of farm animals for normal growth and reproduction; (2) control or eradicate insects and similar pests which attack farm animals; and (3) protect against disease or modify the effects of pathological agents which infest farm animals.

Teacher Preparation

Subject Matter Content

Agricultural chemicals are used predominately in the area of plant science. To a limited, although exceedingly important extent, chemicals are also used in beef, dairy, swine, horse, sheep, and poultry production. This unit examines the setting within which different agricultural chemicals are used.

1. The problem or setting

The damage which is attributable to parasites, malnutrition, disease, and insect infestation of dairy, livestock, and poultry amounts to several hundred million dollars a year. The use of chemicals to limit these losses has in the past been an important factor and promises to become even more important in the future.

A reckoning of the losses sustained by farm animals due to parasites, malnutrition, disease and insect infestations is most difficult. Some of the losses are direct and readily apparent, others are almost impossible to assess. Often the result of these impairments is death in which case the loss can be a matter of the record. However, the impact of inefficiency and losses of milk, meat, eggs; loss in quality in meat, hides and wool; general unthriftiness and poor health is almost impossible to determine.

In addition to reducing production and lowering the quality of livestock and poultry products, parasites and malnutrition also reduce man's ability to work effectively with animals, increase costs of production, limit choices of livestock to raise, and endanger man's health.

NOTE: The instructor will find excellent supporting data regarding food supplies and animal diseases, economic losses from diseases and parasites, and parasites that attack animals and man on pp. 7-28 of Diseases, 1956 Yearbook of Agriculture.

In examining the problem related to farm animal health and in reviewing the setting of the problem locally, the instructor

should make an effort to show the very high relationship which exists among the effects of malnutrition, infestation by external and internal parasites, and infection by bacteria, fungi, and viruses. The recognition and identification of symptoms of stress caused by any one of these forces acting on an animal's health is often very difficult and is indeed complicated when more than one causative factor is active.

2. Possible courses of action to take

a. Prevention and protection

1) Increase the resistance of healthy animals

a) Develop increased natural immunity and resistance through selective breeding

b) Feed adequate ration and balanced diets

c) Immunize by vaccination

d) Manage animals in sanitary ways to prevent infection

e) Administer protective agents - internally, externally

2) Quarantine, isolate healthy animals

3) Disinfact premises, equipment, and devices

a) Infected animals are the source of infection - In order to effectively control disease, do the following:

-- Locate where the infection is.

-- Prevent direct or indirect contact of healthy animals with infected ones - or of premises, feed, water, equipment, etc.

b. Treatment

1) Isolate - quarantine

2) Curative - therapy

a) Administer therapeutic agents

b) Exercise - provide physical therapy

c) Immobilization, restriction of activities

d) Changes in methods of feeding and handling

3. The use of chemicals to maintain the health of farm animals. (Introduce briefly at this point - detailed study will be made later.)

   a. The use of chemicals in the area of animal nutrition and physiology

      1) Carbohydrates
      2) Proteins
      3) Vitamins
      4) Hormones
      5) Mineral Products
      6) Antibiotics
      7) Enzymes
      8) Tranquilizers
      9) Artificial flavors
      10) Antioxidants
      11) Stabilizers
      12) Medicinal drugs
      13) Color fixatives
      14) Growth stimulants

   b. The use chemicals to prevent and control parasites and their effects on farm animals

      1) The concept of antiparasitic chemicals includes all agents used that accomplish, or help accomplish, interruption of the life cycle at stages where parasites are open to attacks.

         a) Protozoacides
         b) Anthelmintics
         c) Insecticides
         d) Acraricides
         e) Ovicides
         f) Larvicides
         g) Repellents

c. The use of chemicals to prevent and control pathogenic bacteria, fungi, and viruses and their effects on farm animals

1) Vaccines

2) Antibiotics

3) Fungicides

4) Vericides

5) Bactericides

4. Major determinants which need to be made in order to develop a program for the use of chemicals to maintain farm animal health

a. Identification of causative factors

b. Kind of chemical to use

c. Time to use chemical

d. Placement, application, or administration of chemical

e. Amount of chemical needed

f. Concentration to use

g. Method of application

h. Ease of application or administration

i. Toxicity, safety, and cost of chemical

5. Problems encountered in using chemicals to maintain farm animal health

a. Danger of residues, drifts

b. Difficulty of accurately diagnosing problem

c. Difficulty of securing cooperation of neighbors, community

d. Mingling and high mobility of animals making control difficult

e. High levels of control of some diseases and parasites leave animals susceptible to attack

f. Animals that appear healthy may spread pathogenic organisms

g. Some disease producing organisms persist for long periods of time and under extreme environmental conditions

h. Use of vaccines may cause the disease itself in a few highly susceptible animals

i. Upon heavy exposure to disease, even those animals that are vaccinated will become diseased

6. The chemical industry - animal health

a. History and background

1) Chemicals and animal nutrition

a) Work of Lavoisier

b) Three nutrients vs/40 nutrients

c) Advances resulting from the study of both feedstuffs and functions of the animal organism

d) Babcock's role in the field of animal nutrition

e) Limitation of diagnostic procedures at any point in time

f) Use of laboratory animals

g) Role of the physicist, geneticist, organic chemist, physiologist, biochemist, and microbiologist

2) Chemicals and parasites

a) Evidences and parasites of farm animals (fossil insects, etc.)

b) Perpetuation of parasites

c) Early attempts to control parasites of farm animals

d) Pre-1940 period

e) 1940-1965 era

3) Chemicals and pathogenic bacteria, fungi, and virus

a) Animal diseases and colonization of America

b) International relationships and animal disease

c) Advancements in vaccines, drugs, disinfectants, microscopes, diagnostic techniques, bacteriology, animal pathology and virology

d) Contributions of research

7. Examples of control programs

   (Cite local successes of effective control, prevention, or eradication programs wherever possible.)

   a. Hoof and mouth disease

   b. Tick fever eradication (cattle)

   c. Pleuropneumonia

   d. Screw worm control

8. Present status and situation

   a. Chemicals and animal nutrition

      1) Number and kinds of nutrients

      2) Number and kinds of chemical food and diet additives and supplements available

      3) Extent of use of chemicals

      4) Number of manufacturers - location

   b. Chemicals and parasites

      1) Number and kinds of parasites commonly encountered

      2) Number and kinds of pesticides on the market

      3) Extent of use of pesticides to control parasites

      4) Major manufacturing companies

   c. Chemicals and pathogenic bacteria, fungi, and viruses

      1) Number and kinds of pathogenic bacteria, fungi, and viruses commonly encountered

      2) Number and kinds of bactericides, fungicides, and viricides on the market

      3) Major manufacturing firms

9. Recent changes and future trends

   a. In the field of animal nutrition

   b. In the field of animal parasites

   c. In the field of pathogenic bacteria, fungi, and viruses

->

Suggested Teaching-Learning Activities

1. Secure a listing of all of the different chemicals available locally for use in the field of farm animal health. Indicate brand names, trade names, active ingredients, company, and instructions for use.

2. Demonstrate the effectiveness and toxicity of a limited number of chemicals used in the field of farm animal health - antibiotics, insecticides, and bactericides should be demonstrated.

3. In cooperation with a local producer on his farm or ranch:

   a. Determine the role chemicals have in the animal health program.

   b. Ascertain the approximate values which accrue as the result of using chemicals in the animal health program.

   c. Examine as many kinds of damage as can be identified which are the results of poor nutrition, insects, and disease.

   d. Study the equipment, buildings, and supplies used on the farm or ranch in the animal health program.

   e. Determine the cost of the animal health program being followed.

4. Repeat No. 3 except make over-all determinations at the local, state, and national levels.

Suggested Instructional Materials and References

Animal Diseases, Yearbook of Agriculture, U.S.D.A., U. S. Government Printing Office, Washington, D.C., 1956.

Insects, Yearbook of Agriculture, U.S.D.A., U. S. Government Printing Office, Washington, D.C., 1952.

Maynard and Loosli, Animal Nutrition, McGraw-Hill Book Company, Inc., New York, New York, 1962.

II. To develop the ability to use important terms, nomenclature, definitions, tables, charts, and guides which are used and also to develop the ability to perform important computations, conversions, calculations and measurements which are commonly used by technical workers in the field of farm animal health.

Teacher Preparation

Subject Matter Content

Note: This unit is presented here at an early point in the study guide in order that the instructor may review it and make plans to make use of the data and information provided for herein throughout the remainder of the course. It is not intended that the unit will be taught as a separate competency, as are the other six major units of the course, but that the material provided for here will be integrated as appropriate throughout the rest of the study. The purpose of this section then is to provide for the pulling together in one place a core of information appropriate to the course.

It will be necessary for the instructor to gather information and materials from various sources including the ones recommended in this unit (Section Six).

Guidelines in the form of an outline for use in summarizing data gathered pertinent to this section are presented.

(Data presented in this same section of the study guide for the course "The Use of Chemicals as Insecticides" may be useful.)

SECTION ONE - General Information

THE STUDENT WILL NEED TO BE ABLE TO:

1. Make use of words, terms, and phrases appropriate to the subject matter of the course. A Glossary of terms will facilitate this usage.

2. Perform measurements, conversions, computations, and calculations commonly used by technical workers in the field. Tables containing units of measurement and tables of equivalents of units will be useful.

a. Tables of measurement

-- Linear measure - length

-- Square measure - area

-- Cubic measure - volume

-- Liquid measure - capacity

-- Dry measure - capacity

-- Weight measure

-- Temperature measure

-- Time measure

-- Other

b. Tables of convenient equivalents

-- Equivalent volumes - liquid measure

-- Equivalent volumes - dry measure

-- Equivalent weight/volume - liquid

-- Equivalent weight/volume - dry

-- Equivalent lengths

-- Equivalent areas

-- Equivalent weights

-- Equivalent temperatures

-- Other equivalents

SECTION TWO - Information Regarding Agricultural Chemicals

THE STUDENT WILL NEED TO MAKE USE OF:

1. A table which lists the common name, active ingredient, and trade name(s) of chemicals studied in the course.

2. An alphabetical listing of chemicals commonly used in the field. Information such as the trade name, name of major producer, composition, formulation, and recommended use is needed.

Example: Diazinon (Geigy)

0, 0 - Diethyl - 0 - (2-isopropyl-4-methyl-6-primidenyl) phosphorothioate. An organic phosphate insecticide - acaricide with contact and stomach poison action.

3. A listing of chemical materials according to the general use

Example: <u>Antibiotics</u>

-- penicillin

-- streptomycin

-- tylosin

<u>Insecticides</u>

-- aldrin

-- DDT

-- malathion

<u>Disinfectants</u>

-- alcohol

-- chresols

-- lye

4. Compatibility charts and tables

   a. Phytotoxicity (with plants, if appropriate)

   b. Chemicals (with other chemicals)

   c. Physical (with other chemicals)

5. Toxicity tables providing LD and LC values (both oral and dermal, acute and chronic) of chemicals studied in the course.

6. Tolerance limitations imposed by F.D.A. upon residues applicable to the subject matter of the course (i.e., herbicides, insecticides, fungicides, etc.)

What is one part per million?

Most lay people have no conception of what constitutes one part per million residue on crops and animal products. The following examples may help you make this interpretation for them:

1. One inch is one part per million in 16 miles.
2. A postage stamp is one part per million of the weight of a person.
3. A one gram needle in a one ton hay stack is 1 ppm.
4. One part per million is one minute in two years.
5. Lay your hand on the ground and it covers 5 ppm of an acre.
6. If one pound of a chemical lands on an acre of alfalfa the hay has 500 ppm. One ounce of a chemical would impart 31 ppm.
7. A teaspoon of material on an acre of alfalfa would impart 5 ppm.
8. One teaspoon of DDT drifting onto 5 acres of alfalfa puts 1 ppm in the hay, and the Federal Law says that the hay must contain none.

(Source--Western Crops and Farm Management)

SECTION THREE- Preparation of Chemicals for Use

THE STUDENT WILL NEED TO BE ABLE TO:

1. Determine whether or not materials prepared and commercially packaged can be applied or administered directly from the container.

2. Determine the total amount(s) of active ingredient(s) contained in a chemical mixture. Mixtures may vary according to weight, volume, concentration, and formulation.

3. Make a determination of the amounts, by weight or by volume, of chemical materials of various levels of concentration to use in order to prepare a given quantity of mixture that will meet recommended or specified dosage or concentration levels. (Weights or volumes of solid or liquid chemicals required to prepare a given quantity of material of different dilutions.)

4. Interpret tables and recommendations for "concentrate" spraying.

SECTION FOUR - Preparation Necessary in Order to Secure Specified or Recommended Application Rates

THE STUDENT WILL NEED TO BE ABLE TO:

1. Compute the area of various plots of land, buildings, corrals, etc. These plots will vary in size, shape, topography, and planting.

2. Determine the speed of a vehicle traveling on the land. (In miles per hour and feet per minute.)

3. Three variables affect the application rate of agricultural chemicals secured in the field - the speed of travel, the effective width of the device applying the chemical, and the total material delivered per unit of time.

   <u>If two of these variables are known, calculate the other in order to secure a specific application rate.</u>

   a. Calibrate sprayers, dusters or metering devices to secure specific delivery rates.

   b. Compute the length of boom, number of outlets, or width of opening to secure specific widths.

   c. Calibrate ground speed to secure specific rate of forward travel.

4. Use tables of "Rate of Equivalents"

   Example: 1 ounce per square foot = 2722.5 pounds per acre

5. Calculate the quantity of spray per length of run which will be equivalent to a specific application.

6. Determine the amounts of chemicals required to spray or dust various areas or numbers of animals.

7. Consider the effect of particle size on drift and deposit. (Prepare spray drift and deposit table.)

<u>SECTION FIVE</u> - Information Relative to Diagnosis and Prescription

<u>THE STUDENT WILL NEED TO MAKE USE OF</u>:

1. Tables, charts, and guides which summarize situations encountered in agricultural production in which the use of chemicals is appropriate. Materials to use and methods of application are suggested.

Examples of form used:

Plant, Soil or Host	Pest, Disease or Condition	Causative Agent or Factor	When to Treat	What Material to Use
Sheep	Insect	Sheep ticks (Keds)	As Needed	Diazinon

Active Ingredient Per 100 Gal. of Water	Formulation	Amount Concentration Req'd	Method of Application	Remarks
1/2 lb. Wettable Powder	Wettable Powder	0.03% active	High pressure spray	Apply at the rate of 1 gal. of diluted spray per animal - use not later than 14 days before slaughter.

2. Graphs, charts, tables, and other illustrative materials available and supportive of the unit under consideration.

Examples:

a. Graphical relationships

-- time versus residue levels

-- rates of application versus levels of effectiveness

-- levels of concentration versus levels of effectiveness

-- stage of development or growth versus effectiveness of chemical control, etc.

SECTION SIX - Sources of Materials

Pfodt, Robert E., Fundamentals of Applied Entomology, The MacMillan Company, New York, N. Y., 1962. Contains an appendix of scientific names of insects and a glossary of terms and words.

Farm Chemicals Handbook, Meister Publishing Company, Willoughby, Ohio, 1966. A comprehensive pesticide dictionary is included.

Agricultural Chemicals, Simmons Publishing Company, Davis, California, 1964. A glossary of pesticide terms and useful formulas are presented.

Seiden, Rudolph, Insect Pests of Livestock, Poultry, Pets, and Their Control, Springer Publishing Company, Inc., New York, 1964. A pocket reference book which presents a review of insects, pesticides and recommendations for using pesticides.

Seiden, Rudolph, and Pfander, W. H., The Handbook of Feedstuffs, Springer Publishing Company, Inc., New York, 1957.

The Merck Veterinary Manual, Merck and Co., Inc., Rahway, New Jersey, 1961.

The Feed Bag, Red Book for 1965, Editorial Service Co., Inc., Milwaukee, Wisconsin, 1965.

Summary of Registered Agricultural Pesticide Chemical Uses, Second Edition, U.S.D.A., Agricultural Research Service, Supt. of Documents, Washington, D.C., July 1, 1964. (Plus supplements) - uses, tolerances, dosages, limitations, principle formulations given.

Pesticide Official Publication and Condensed Data on Pesticide Chemicals, Association of American Pesticide Control Officials, Inc., 1955. Definition of terms and summary of pesticide laws especially useful.

Specification for Pesticides, Second Edition, World Health Organization, Geneva, 1961.

Suggested Teaching-Learning Activities

1. Divide the class into groups and assign each group one of the five major sections of this unit to expand and develop further sources of information The data used should be the very latest available. Have the students send for resource materials.

2. Identify at this point in the study as many of the various kinds of information and data as will be used in the remainder of the course. Invite students to be on the lookout for such materials.

III. To learn to recognize and identify: (1) Conditions essential for the prevention of nutritional deficiencies, parasitic infestations, and disease caused by pathogenic bacteria, fungi, and viruses in farm animals; and (2) Symptoms of stress commonly exhibited by farm animals which are the results of nutritional deficiencies, infestations of parasites, and diseases caused by pathogenic bacteria, fungi, and viruses.

Teacher Preparation

Subject Matter Content

Note: Physiological stresses in farm animals can be brought about by a large number of factors. Nutritional deficiencies, infestations by parasites, and diseases caused by pathogenic bacteria, fungi, and viruses are only some of the forces which act to upset the normal functioning of life processes. In some instances the causative factor(s) is readily apparent but very often stress is brought about by factors, acting singly or in combination, which are most difficult to identify.

A thorough review of the subject matter studied in parasitology, pathology, feeds and feeding, and entomology is recommended.

1. Requirements for normal growth and development of farm animals.

   a. Signs of good health

2. Review and study of diseases, damage, injury, and/or abnormalities caused by:

   a. Parasites (small animals) which live in or on the farm animals. (Although bacteria, fungi, and viruses which infest farm animals might be considered as parasites, usage of the term has limited its meaning to animal organisms.)

      1) Study may be made in detail of parasites most likely to be encountered in the local and regional areas. The instructor will select those considered most important. The following study guide can be modified as appropriate:

         a) Common name of parasite

         b) Scientific classification

         c) Life history, appearance, habits

         d) Distribution

         e) Importance and types of injury

f) Kind of control program considered most effective

g) Important points of life cycle to note particularly

h) Economic importance of parasite, parasite control

i) Injury, damage, or stress caused by parasites

-- specific diseases

-- cause nodules or growths

-- severe annoyance

-- absorb food

-- suck blood, produce anemia

-- serve as alternate host of diseases

-- destruction of tissues and organs of every kind in the body, functions interfered with

-- inflammation, irritation

-- unthriftiness, emaciation, weakened condition

-- inhabitation in the blood causing blood clots and disease

-- elaboration of materials toxic to animals

-- produce mechanical injuries, bite, lacerate

-- lowered production, reduced resistance

-- obstruct passages

2) Protozoa

a) Sporozoans

-- Coccidia

-- Sarcosporedians

b) Flagellata

-- Trypanosomes

-- Histomonads

-- Trichomonads

c) Ciliates

d) Rhizopoda

-- Amebae

3) Platyhelminthes

a) Flukes

b) Tapeworms

4) Nemathelminthes

a) Roundworms (Nematodes) - main disease producing worm parasite of farm animals

5) Acanthocephala

a) Thorn-headed worms

6) Arthropoda

Most arthropods are external parasites, but there are a few who live a part of their cycle inside the body of the animal.

a) Ticks - all ticks are parasitic on animals

b) Mites - most mites are free living or feed on plants, but several species are serious parasites of animals

c) Insects - most numerous of the arthropodes

b. Bacteria, fungi, viruses

1) Pathogenic bacteria

2) Pathogenic fungi

3) Pathogenic viruses

c. Nutritional diseases

1) Overeating

2) Nutritional anemia and deficiencies

3) Imbalance of nutrients

d. Metabolic diseases (noninfectious)

e. Poisoning

1) Poison in feed

2) Fluorine poisoning and air pollution

3) Poisonous plants

4) Insecticides, herbicides, fungicides

Suggested Teaching-Learning Activities

1. Add to and improve insect collections the student prepared in his entomology class. Include insects and parasites of farm animals.

2. Prepare specimens and materials for study of parasites, bacteria, virus, and nutritional diseases common to farm animals.

3. With the aid of a local veterinarian, examine symptoms of stress exhibited by farm animals which have been caused by various agents. Study as many different kinds of stress as can be identified.

Suggested Instructional Materials and References

Insects, The Yearbook of Agriculture, U.S.D.A., Superintendent of Documents, Washington, D.C., 1952.

Animal Diseases, The Yearbook of Agriculture, U.S.D.A., Supt. of Documents, Washington, D.C., 1956.

Maynard and Loosli, Animal Nutrition, McGraw-Hill Book Company, Inc., New York, 1962.

Metcalf, Flint, Metcalf, Destructive and Useful Insects, Third Edition, McGraw-Hill Book Company, Inc., New York, 1962.

Pfadt, Robert E., Fundamentals of Applied Entomology, The MacMillan Company, New York, 1962.

Seiden, Rudolph, Insect Pests of Livestock, Poultry, and Pets and Their Control, Springer Publishing Company, Inc., New York, 1964.

IV. To become knowledgeable at the technical level regarding various chemicals commonly used in the field of farm animal health.

Teacher Preparation

Subject Matter Content

1. Common types of formulations

a. Dusts	k. Baits
b. Granular formulations	l. Serums
c. Wettable powders	m. Bacterins
d. Solutions	n. Smears, rubbing devices
e. Emulsifiable concentrates	o. Ointments
f. Aerosols	p. Capsules
g. Fumigants	q. Balls
h. Pills	r. Powders
i. Vaccines	s. Liniments
j. Shampoos, soaps	t. Tinctures

2. Adjuvants

   a. Adjuvants are accessory ingredients used in formulating insecticides, acaricides, or repellents. They may have some biological activity or they may be inert ingredients (carriers, diluents, solvents, emulsifiers, wetting agents, or spreaders). Adjuvants are used in a chemical formulation to help in developing its full effectiveness.

   b. Adjuvants used in formulating chemicals for use in connection with farm animal health include:

1) Alcohol	7) Chloroform
2) Antiresistant	8) Eucalyptus oil
3) Arsenic sulfide	9) Fish oils
4) Bone Oil	10) Linseed oil
5) 2 - Butoxyethanol	11) Mineral oil
6) Carbon tetrachloride	12) Petroleum

13) Petroleum solvents
14) Rosin
15) Sodium arsenite
16) Sperm oil
17) Sulfur
18) Surface-active agents
19) 1, 1, 1 - trichloroethane
20) Triethanolamide
21) Turkey red oil
22) Turpentine
23) Turpentine oil
24) Xylene
25) Vegetable oils
26) Zinc oxide

3. Chemicals used to control parasites of farm animals. Includes chemicals used on animals, buildings, and premises.

a. External parasite control - primarily insecticides, acaricides, and repellents.

1) Aldrin
2) Allethrin
3) Anthracene oil
4) Baytex
5) Benzyl Benzoate
6) Benzene hexachloride
7) Benzene sulfoxide
8) Butanate
9) Butoxide
10) Carbolineum
11) Carbon tetrachloride
12) Chlordane
13) Chloroform
14) Chlorthion
15) Ciodrin
16) Coal tar oils
17) Coal tar disinfectants
18) Co Ral
19) Creosote dips
20) Creosote oil
21) Crude oil
22) DDT
23) DDVP
24) Delnav
25) Diazinon
26) Dibrom
27) Dibutyl succinate
28) Dicapthou
29) O-Dichlorobenzene
30) Dieldrin
31) Diethyldiphenyldichloroethane
32) Dimethoate
33) Dimetilan
34) Diphenylamide

35) Dipterex
36) EQ 335
37) Heptachlor
38) Kerosene
39) Lethane 384
40) Lethane 384 Special
41) Lindane
42) Malathion
43) Methoxychlor
44) Methyl Bromide
45) MGK 264
46) MGK R-11
47) MGK R-326
48) Mineral oil emulsion
49) Naphthalene
50) Nicotine
51) Nicotine dip
52) Nicotine dust
53) Nicotine sulfate
54) Nicotine sulfur dust
55) Parathion
56) Pentachlorphenol
57) Petroleum dip
58) Petroleum solvents
59) Phenothiagene
60) Pine Oil
61) Pine tar
62) Piperonyl Butoxide
63) N-propyl isome
64) Pyrethrum
65) Ronnel
66) Rotenone
67) Sabadilla
68) Sesame oil
69) Sevin
70) Silica aerogel
71) Smear No. 62, 335
72) Sodium arsenite
73) Sodium fluoride
74) Sodium fluosilicate
75) Sulfoxide
76) Sulfur
77) Sulfur dioxide
78) Sulfur ointment
79) Sulphhenone
80) Surface-active agents
81) TDE
82) TEPP
83) Thanite
84) Toxaphene
85) Turpentine oil
86) Xylene

b. Internal parasites - primarily protozoacides and anthelmintics.

1) Phenothiazine
2) Sodium fluoride
3) Cadmium oxide
4) Cadmium anthranilate
5) Diethylcarbamazine
6) Piperazine salts
7) Toluene (Methylbenzene)
8) Metallic arsenates
9) Antibiotics (see 4b (1) next section)
10) Sulfonamides (see 4b (2) next section)
11) Anthelin
12) N - Butyl chloride
13) Carbon disulfide
14) Carbon tetrachloride
15) Cunic solution
16) Dithiazanine iodide
17) Hexachloroethane
18) Hygromycin
19) Tetrachloroethylene

4. Chemicals used to prevent or control diseases of farm animals.

a. Disinfectants

1) Alcohol
2) Bichloride of mercury
3) Boric acid
4) Cationic bactericides (commercial products including quarternary ammonium compounds)
5) Cresols
6) Formaldehyde
7) Hypochlorites
8) Iodine
9) Lime
10) Lye
11) Phenols
12) Sal soda
13) Soap
14) Soda ash (sodium carbonate)

b. Chemicals used to prevent or control infectious agents

1) Antibiotics

a) Aureomycin (chlortetracycline)
b) Bacitracin
c) Carbomycin
d) Chloromycetin (Chloramphenical)

e) Dihydrostreptomycin
f) Erythromycin
g) Neomycin
h) Octidone
i) Penicillin
j) Progidiosim
k) Puromycin
l) Streptocin
m) Terramycin (Oxytetracycline)
n) Tetraycline

2) Sulfonamides

a) Sulfabromomethazine
b) Sulfadiozine
c) Sulfaguanidine
d) Sulfameragine
e) Sulfamethazine
f) Sulfamethizole
g) Sulfanilamide
h) Sulfapyrazine
i) Sulfapyridine
j) Sulfathiazole
k) Phthalylsulfathiazole
l) Succinylsulfathiazole

3) Nitrofurans

a) Nitrofurantoin (Furadantin)
b) Nitrofurazone (Furacin)
c) Nitrofurfuryl methyl ether (Furaspor)

4) Biologicals

a) Bacterins
b) Vaccines
c) Serums
d) Fungicides

Note: Only persons having special training and knowledge of farm animals diseases and experienced in the use of biological products should attempt the immunization of farm animals. Work by the technician should be done under the supervision of a professional--the Veterinarian.

c. Chemicals used as feed additives

1) Growth stimulants (including hormones)

a) Antibiotics

-- Penicillin
-- Streptomycin
-- Chlortetracycline
-- Oxytetracycline
-- Bacitracin
-- Cloramyphenicol
-- Nysatatin
-- Oleandomycin
-- Erthyromycin
-- Tylosin

b) Arsenicals

-- Arsanilic acid

-- 3 - Nitro - 4 - hydroxy - phenyl - arsonic acid

-- p - ureidobenzenearsonic acid

-- 4 - nitro-phenyl arsonic acid

-- Arsenosobenzene

2) Preservatives - (antioxidants, stabilizers)

a) BHA
b) BHT
c) Calcium propionate
d) Calcium sorbate
e) Citric acid
f) Proprionic acid
g) Sodium benzoate
h) Sodium nitrite

3) Vitamins

a) Vitamin A (animal form)

Carotene (plant form)

b) Vitamin D (anti-rachitic, sunshine vitamin)

Vitamin D_2 - (plant form)

Vitamin D_3 - (animal form)

c) Vitamin E (anti-sterility vitamin)

Alpha - tocopherol

d) Vitamin K

Anti-hemorrhagic, blood coagulation vitamin

e) Thiamine

Vitamin B

Vitamin B_1

Anti-beri-beri, anti-neuritic vitamin

f) Riboflavin

Vitamin B_2

Vitamin G

g) Niacin

Nicotinic acid, nicotinic acid amide

Pellagra - preventive factor

Anti-black tongue factor

h) Pantothenic acid

Vitamin B_6

i) Biotin

Vitamin H

Anti-egg white injury factor

j) Folacin

Folic acid

k) Vitamin B_{12}

Colbalamin

The Red Vitamin

l) Ascorbic Acid

Vitamin C

m) Choline or choline chloride

n) Inositol

Inosite, meat sugar

o) Para-amino-benzoic acid

PABA

p) Unknown factors

Vitamin B_{13}, grass juice factor and other unknowns

4) Guide for the study of vitamins

Names, synonyms

Description, properties, units

Deficiency symptoms

Sources

Approximate requirements

5) Hormones - for physiological stimulation through feeds

Dienestrol Diacetate

Diethylstibestrol

Thyroprotien

6) Amino acids

Methionine

Glycine

Methionine hydroxy analogue calcium

7) Urea

8) Flavoring compounds

9) Enzymes

10) Mineral products

a) Packing house by-products

-- Bone ash

-- Bone black or bone charcoal

-- Spent bone black

-- Steamed bone meal

-- Special steamed bone meal

-- Cooked bone meal

-- Precipitated bone phosphate

b) Natural and prepared minerals

-- Calcite

-- Ground limestone

-- Chalk rock

-- Precipitated chalk

-- Oyster shell flour

-- Shell flour

-- Precipitated calcium carbonate

-- Magnesium limestone

-- Iodized salt

-- Low flourine rock phosphate

-- Deflourinated phosphate

c) Additional officially recognized mineral ingredients

-- Cobalt acetate

-- Cobalt carbonate

-- Cobalt chloride

-- Cobalt sulfate

-- Copper carbonate

-- Copper hydroxide

-- Copper sulfate

-- Iron carbonate

-- Iron phosphate

-- Iron sulfate

-- Red iron oxide

-- Magnesium sulfate

-- Manganese carbonate

-- Manganese oxide

-- Manganese phosphate

-- Manganese sulfate

-- Dicalcium phosphate

-- Rock phosphate

-- Soft phosphate with colloidal clay

-- Tricalcium phosphate

-- Sodium bicarbonate

-- Sodium chloride

-- Sodium sulfate

-- Glauber's salt

-- Sulfur

-- Zinc carbonate

-- Zinc sulfate

11) Color fixatives

5. The following outline may be useful as a guide in the study of the chemicals presented in this unit.

a. Guide for the study of agricultural chemicals

Note: The instructor will determine which chemicals are to be studied in depth. This selection of course depends upon the requirements of local areas and situations. Other items should be added to the guide as appropriate.

1) Chemical name (active ingredient)

2) Empirical formula

3) Chemical structure

4) Common name

5) Trade name(s) and major producer(s)

6) Melting point

7) Vapor Pressure

8) Solubilities

9) Odor

10) Color

11) Density

12) Physical state (liquid, solid, gas)

13) Corrosive action

14) Flammability

15) Stability

16) Compatibility

17) Suitable diluents

18) Concentrations

19) Purities/grades

20) Mixtures available

21) Industrial preparation

22) Formulations for use/additives used

23) Analytical methods

24) Analysis of mixtures

25) Phytotoxicity

26) Toxicity (LD_{50}, LC, ppm oral, dermal, acute, chronic)

27) Special hazards

28) Residues likely, tolerance limitation

29) Synergists possible for use

30) Intended general use (insecticide, fertilizer, nematocides, etc.)

31) Intended specific use

32) Antidotes and first aid

33) Factors which limit the effectiveness of the chemical (such as temperature, sunlight, water, etc.)

In what animals or on what premises can the chemical be used safely?

Suggested Teaching-Learning Activities

1. Prepare a kit of samples representative of the chemicals commonly used in the local area in the field of farm animal health. Classify and assemble according to the outline presented in this unit.

2. Prepare chemicals for use according to different formulations suggested in the study guide (as appropriate).

3. As a class project, develop a master study guide of the pertinent properties and characteristics of selected chemicals. Assign the study of different chemicals to each member of the class and summarize the data reported back.

Suggested Instructional Materials and References

Noble, Elmer R., and Glen A., Parasitology, the Biology of Animal Parasites, 2nd Edition, Lea and Febiger, Philadelphia, Pa., 1964.

Miller, W. C., and West, G. P., Encyclopedia of Animal Care, The Williams & Wilkins Company, Baltimore, 1962.

The Merck Veterinary Manual, Second Edition, Merck and Company, Inc., Rahway, New Jersey, 1961.

Animal Diseases, The Yearbook of Agriculture, U.S.D.A., Superintendent of Documents, Washington, D.C., 1956.

Dykstra, R. R., Animal Sanitation and Disease Control, Interstate Printers and Publishers, Danville, Illinois, 1961.

Bailey, J. W., Veterinary Handbook for Cattlemen, Springer Publishing Co., New York, N. Y., 1958.

Seiden, Rudolph, Insect Pests of Livestock, Poultry, and Pets and Their Control, Springer Publishing Co., New York, 1964.

Brown, A. W., Insect Control by Chemicals, John Wiley & Sons, Inc., New York, 1951.

The Feed Bag, Red Book for 1965, Editorial Service Co., Inc., Milwaukee, Wisconsin.

V. To gain an understanding of the principles and concepts related to the use of chemicals in the field of farm animal health.

Teacher Preparation

Subject Matter Content

The ability of man to secure an acceptable degree of control over insects, acarides, bacteria, fungi, and viruses which infest farm animals and also the ability to be able to avert the consequences of malnutrition is dependent not only upon his understanding of the technical attributes and characteristics of the chemical resources available for use in this field, but also upon his knowledge and understanding of the physical and biological world in which use is made of these chemicals.

1. Chemicals used in the area of farm animal health are effective to the extent that they are used within specified conditions and applied or administered in an acceptable manner. Variables of concern include: (assuming identification has been made of agents or factors involved which provide the basis for concern, i.e., insects, helminth, disease, etc.)

   a. Selection of the appropriate chemical to use

   b. Formulation to use

   c. Concentration to use

   d. Amount/dossage to apply or administer

   e. Time to apply or administer

   f. Method of application or administration

   g. Placement

   h. Weather

   i. Safety hazards, precautions

2. Principles of Parasite Control

   a. Immunological techniques cannot be used as a major aid to systemic control of parasites.

   b. Individual species are limited in distribution and intensity by a sensitive adjustment to climate and other factors and by the kinds of animals in which they develop.

c. Parasitic injury is typically inapparent and unrecognizable during the early stages of infestation. Indeed if the infestation is not heavy the losses may be so insidious and unspectacular as to go unnoticed but the injury is generally quantitative in its effect.

d. The individual cycles of development within host animals are so fixed, limited, and finite that, despite multiplication in and on their hosts, the damaging effects generally are directly correlated with degree of exposure and magnitude of infection - (not true of bacteria, virus).

e. Parasitism is essentially a herd or flock disease. Treatment, sanitation, and preventative medication must be approached on this basis.

f. Parasites are exceedingly specific in their cycles, forms, habits, modes of life, and disease causing potentiality.

g. Parasite control is the judicious use of feasible, profitable measures to minimize the losses and hazards of parasitism. Sanitation and medication, if used enough, must ultimately spell eradication.

h. Breaking the chain at its weakest link is the essence of every effort directed against parasites.

A parasite is usually more vulnerable to attack at one stage of its life cycle than at another.

i. Time and environmental conditions of temperature and precipitation determine the distribution, seasonal occurrence, and abundance of many parasites. Good control measures takes advantages of environmental influences.

j. The expanding knowledge of parasites and their relationship to livestock makes it clear that efficient control goes hand in hand with sanitation, good feeding and grazing, proper stocking, intelligent breeding, surveillance, and good management.

3. Principles Relating to Disinfection

a. Disinfection, destroying pathogenic agents, is possible only after thorough cleaning.

b. Disinfectants destroy only microorganisms touched by the chemical, embedded organisms are untouched. All soil that contains embedded organisms should be removed from surfaces by cleaning.

c. Wetting agents improve the action of some chemicals to obtain rapid contact or to "wet" organisms. Some agents are combination detergent-cleaners and sanitizers.

d. Disinfectants work best when they and the surfaces to be disinfected are warm.

e. The pH of the disinfectant or the item to be disinfected determines the effectiveness of most agents.

f. Organic type disinfectants react slowly. The hypochlorites are the most rapid acting.

g. Generally speaking the higher the concentration used, the shorter the time of kill.

h. The presence of organic matter in the disinfecting solution or on the surfaces to be treated may reduce germicidal activity to a point where no disinfection results.

i. Hard waters interfere with some disinfectants because of the presence of calcium, magnesium, or iron.

4. Concepts and principles related to entomicides

a. The problem of controlling arthropods is complicated by needing to consider:

1) The behavior of the pest

2) Accessibility

3) Differing environmental situations

4) The host's welfare

5) The welfare of the consuming public

b. Not all pests of farm animals are resident animals; a few are "visitors" by habit. (Flies, mosquitoes)

c. Even though a particular chemical may be highly toxic once inside the body of a particular arthropod, it may prove to be of minor effect if sufficient quantities cannot be conveniently introduced under practical conditions of treatment.

d. Local breeders, whether on the host or in its immediate vicinity, are much more easily subject to control than distant breeders. Breeding site control is often not within the practical reach of the agriculturist.

e. Entoma vary in their susceptibility to entomicides--both as individuals and as species.

f. Not all relationships between entoma and their hosts are understood. The physiological responses of hosts, such as weight gains, production of milk and eggs are not all adversely affected. The economic relationships between the cost of treatment and return to the producer need much more precise evaluation.

g. It is most likely that chemical agents have multiple effects, toxicity-wise as well as in the modification of behavior.

h. The similarity of physiological processes in mammals and in arthropod pests is the basis of the serious difficulty encountered when interference in these processes in the one is sought and noninterference in the other is desired. The problem of differential toxicity of chemicals to arthropods and to mammals is one of the most serious ones associated with the use of these toxicants.

Suggested Teaching-Learning Activities

1. Apply or administer various toxicants and feed additives reviewed in the previous unit. Make applications of chemicals to control insects and other arthropods of ectoparasitic nature; treat animals for the control of indo-parasitic infestations; practice sanitation, disinfection and control of pathogenic bacteria, fungi, and virus; and formulate and mix feed rations.

2. Demonstrate various incompatibilities encountered in using entomicides and feed additives.

3. In laboratory controlled trials, make various applications and administrations of chemicals studied. Vary the chemical used, formulation, concentration, dosage or amount used, time, method of application, placement, and environmental factors of temperature, light and humidity.

Suggested Instructional Materials and References

Advances in Pest Control Research, Vol. 4, Metcalf-Editor, Interscience Publishers, Inc., New York, 1961.

Animal Diseases, The Yearbook of Agriculture, U.S.D.A., Superintendent of Documents, Washington, D.C., 1956.

VI. To acquire and be able to practice the skills and abilities essential in using chemicals to maintain the health of farm animals.

Teacher Preparation

Subject Matter Content

Planning a program for maintaining the health of farm animals and its subsequent implementation are critical concerns of the agricultural chemicals technician as he attempts to make practicable application of theoretical understandings.

The decision to use chemicals in a program of maintaining the health of farm animals is based upon many considerations. Decisions of this kind are influenced to a considerable extent by the economics of the situation although other considerations are becoming of greater importance. But once the decision is made to use chemicals, the point is reached where program planning must proceed. The technician will now draw upon the technical knowledge and understandings gained thus far in the course.

General guidelines for planning programs in the use of chemicals in the field of farm animal health are proposed. Additions and modifications should be made as appropriate.

1. Planning a program - "The Use of Chemicals to Maintain Health of Farm Animals."

    a. Determine what the situation is or what it is likely to be if chemicals are not used.

        1) What is the threat - short-range, long-range?

        2) What is the problem or major concern?

        3) What risk is involved; what are the consequences to be expected?

        4) What level of health can reasonably be expected with; without the use of chemicals?

        5) What resources are available for use?

        6) What are the alternatives available within the chemical field?

    b. Establish goals and objectives

        1) What is desired, what is to be attempted, what accomplishments are to be sought.

a) Is it possible and attainable yet challenging and worthwhile?

b) Is it measureable - what tools of measurement are to be used - how will we know of our progress?

2) Spell out goals and objectives in terms of:

a) The animal or animal product under threat

b) The agent or factor of primary importance (parasite, disease, pathogen, deficiency, etc.)

c) The use of necessary inputs

d) The control to be exercised over other variables

c. Spell out ways and means to accomplish goals and objectives - devise a plan of action

1) Establish priorities and allocate resources

a) Determine what the operational framework is

b) Spell out limitations

c) Ascertain the specific uses to be made of chemicals

d) Make selection of the materials to be used

e) Plan for the use of the chemical(s)

-- Determine the formulation to be used

-- Ascertain the appropriate time application or administration to be made

-- Decide on the concentration needed

-- Determine amounts to apply or dosage to administer

-- Prepare the chemicals for application/ administration

-- Select method of application/administration

-- Apply (identify and be prepared to control as many of the other variables as possible that might affect the successful use of the chemical(s))

f) Plan for an evaluation of results obtained

2. Aids to program planning

The use of chemicals to maintain the health of farm animals encompasses a large field. A large number of resources regarding animal nutrition, animal pathology, and animal parasitology have been prepared for use in the educational field. It must be recognized, however, that research in these three broad areas is highly productive. New products, new concepts, new problems, and new and improved technologies are reported each year. The practitioner will find it necessary to learn of these advances in order to stay competitive.

a. The nature of the aids available

1) Before any chemical - pesticide, drug, or feed additive can be offered to the public for use it must conform to specified standards, tests, and regulations prescribed by federal and state statutes. Information is available from the agency in each state charged with administering the provisions of these laws and regulations.

2) Educational agencies of the government and the U.S.D.A., through the Superintendent of Documents, make available reports and recommendations of its supporting agencies (such as ARS, AMA) and the Cooperative Extension Service and Agricultural Experiment Stations, through the State Land Grant Colleges, provides the results of experimentation and makes recommendations. These reports are the results of carefully controlled trials and observations and much effort is made to provide current information.

3) Many of the commercial chemical companies have supporting research departments. Huge sums of money are spent in developing new products, technologies, and procedures. Some of the most highly qualified workers in the nation are engaged by these firms, and it is reasonable that the results of their efforts should be of value. Many excellent educational materials are made available to public educators by these firms.

4) Technical and professional workers in the field continue to have published, through commercial publishing firms, results of their study and investigations. These publications are often suitable for texts and reference books. Commercial printing firms also furnish timely information and data by means of magazines and periodicals.

5) Special interest groups of national and state-wide scope are sources of valuable educational materials.

b. The kinds of planning aids available

1) Farmers' bulletins

2) Agricultural information bulletins

3) Leaflets

4) Circulars

5) Charts

6) Guides

7) Film strips

8) Movies

9) Handbooks

10) Texts and reference books

11) Lectures

12) Experiments, trials, demonstrations

13) Laboratory exercises

c. Kinds of information available - data on:

1) The control of a specific pest (chicken mite, Ked, etc.)

2) The control of pests which infest a specific host (Hog louse, wool maggot, etc.)

3) The control of pests which infest similar hosts (cattle mange, biting horse lice, etc.)

4) The control of pests which infest animals that belong to large groups (poultry lice, livestock flies, etc.)

5) The control of pests according to locus of habitation (external, internal)

6) The prevention and treatment of specific diseases (rickets, anthrax, etc.)

7) The prevention and treatment of diseases affecting classes of livestock (horses and mules, poultry, swine, etc.)

8) The prevention and treatment of diseases brought about by various causes (pathogens, parasites, nutritional imbalance, metabolic upset, poisoning, etc.)

9) The prevention and treatment of diseases affecting several species of animals (flies, gnats, mosquitoes, etc.)

Suggested Teaching-Learning Activities

1. Select a farm or ranch nearby and with the cooperation of the owner plan a comprehensive program to maintain the health of the animals found on the farm.

2. Randomly select six or eight ranches in the area and survey them as to the kind of animal health program in effect. Evaluate the results being obtained and suggest ways for improvement.

VII. To acquire the skills needed to lawfully and safely handle, transport, store, and apply or administer chemicals used to maintain farm animal health.

Teacher Preparation

Subject Matter Content

Note: Much of the information presented in this section (VII) was taken from the Teachers Handbook, Agricultural Chemical Safety, California State Polytechnic College, San Luis Obispo, 1966.

1. The lawful use of chemicals in the field of farm animal health

   a. The need for laws and controls in this field

      1) Certain animal diseases and infestations by parasites are so devastating that no individual farmer or rancher could long protect his herds and flocks against these onslaughts. Where human health is involved, the regulatory functions of federal and state organizations are brought into force.

      2) The physical nature and chemical composition of commercial feeding stuffs varies so extensively that control and regulation by federal and state organizations is required in order to protect the interest of the consuming and general public.

   b. The use of pesticides to control insects and other pests which might infest farm animals.

      1) All pesticides are poisons and should be handled carefully. Some are more toxic to insects and similar pests than they are to warm-blooded animals, including man, to whom they may be relatively safe. Some are exceedingly toxic to both pests and man and thus require careful handling. All these materials can be safely used if the proper precautions are taken.

         The interest of pesticide regulatory agencies is centered around the following major topics:

         a) Toxicity of pesticides to mammals and pests

            Mammalian toxicities of a pesticide is generally determined by feeding carefully measured amounts of the chemical to white rats. These toxicities are

expressed in milligrams of poison per kilogram of body weight of animal necessary to kill fifty per cent of the test animals. This figure is referred to as the LD_{50} (lethal dose) for the poison. Two LD_{50} values are often determined - oral and dermal.

Since toxicity values are expressed on a weight basis, they take into account the fact that less poison is necessary to kill a small animal than a large one. Man may be many times more sensitive as the rat on a per weight basis, so that the LD_{50} figures given for the rat may be much higher than for humans. LD_{50} values should be used to show the relative order of toxicities of the different materials and should not be considered as the amounts safe for humans. Representative values are shown in the following table:

ACUTE ORAL LD-50 VALUES FOR WHITE RAT[1]

Insecticide	mg./kg.	Insecticide	mg./kg.
TEPP	1.3	Diazinon	125
Di-Syston	1.9	Coumaphos (Co-Ral)	150
Parathion	3.1	Sodium fluoride	203
Calcium Arsenate	20.0	Dimethoate (Cygon)	245
Paris green	22.0	DDT	250
Endrin	25.0	Entex (Baytex)	310
Dinitrocresol	26.0	Chlordane	458
Nicotine	55.0	Trichlorfon (Dipterex)	500
Dichlorvos (DDVP)	56.0	Carbaryl (Sevin)	570
Aldrin	67.0	Dicapthon	572
Toxaphene	69.0	BHC (Technical)	600
Pentachlorophenol	77.0	Allethrin	680
Dieldrin	81.0	Thanite	1000
Heptachlor	90.0	Malathion	1000
Lethane 384	90.0	Chlorthion	1506
Lead Arsenate	100	Ronnel (Korlan)	2500
Ciodrin	107	TDE (Rhothane)	3406
Endosulfan (Thiodan)	109	Sabadilla	4000

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[1] Pesticide Manual, 1965 North Carolina Handbook, Division of General Extension, Raleigh, North Carolina, 1965, p. 6.

Rotenone and pyrethrins are not included in the table of "Acute Oral LD-50 Values." These materials are considered as safe to use by man despite the fact that their oral toxicities are in the range of 0.1 to 0.2 oz. per 100 lbs. to certain laboratory animals. All mammals do not react in the same manner to these materials. With rotenone, for example, man is the least seriously affected, while swine are very susceptible.

The oral LD-50 values given above are for technical materials. Values for formulated materials would be inversely proportional to the percentage active ingredient in the formulation. In other words, a 25% formulation would require four times the amount as the technical material. The hazards involved in handling any insecticide will depend on the toxicity of the active material and also on the dilution of the active material in the formulation. To illustrate further, if a compound has a mammalian toxicity of 20 mgs./kg., but is used at 1%, it would be less hazardous than another compound which has a mammalian toxicity of 100 mgs./kg., but is used at 10%.

To convert from mgs./kg. to ounces/100 lbs. (so that rough estimates may be made for man) divide 625 into the figure given in mgs.

Ex. 1.3 mg./kg. $\div$ 625 = 0.002 oz./100 lbs.

It must be noted that the values given above are for acute oral toxicities. This, in general, is the most toxic method of administering a poison aside from direct injection. Some poisons can be more hazardous through skin absorption in repeated small doses than in one larger oral dose. This is true of most phosphates which inhibit cholinesterase activity. The body requires considerable time to reactivate the inhibited material so that frequent repeated small doses could prove fatal.

Injury from insecticides is not always immediate. Prolonged exposure to sub-lethal quantities may cause permanent damage to the kidneys and liver.

Most fumigants vaporize so rapidly that it is impossible to obtain acute oral toxicity data, thus they are not found in the preceding table. In order to give some ideas as to their relative dangers, the following table gives the estimated amounts of the more common fumigants that are dangerous to humans during a one-hour exposure.

Fumigant	Pounds per 1,000 cu. ft. of air considered dangerous to man during 1 hour exposure
Chloropicrin*	0.007
Hydrogen cyanide	0.007
Carbon disulfide	0.2
Methyl bromide	0.5
Ethylene dichloride	0.8
Ethylene dibromide	1.6
Carbon tetrachloride	9.5

*Although chloropicrin is one of the most toxic materials, it can be detected by humans at 0.0005 lb./1000 cu. ft. and produces tears at 0.001 lb./1000 cu. ft. It would be nearly impossible for a person to remain voluntarily in a concentration of chloropicrin that would be dangerous to life.

All fumigants are highly toxic and should not be inhaled. When working in closed places it is always necessary to wear a suitable gas mask. Some fumigants such as hydrogen cyanide should never be used except by trained fumigators, since skin absorption is equally as dangerous as inhalation. Carbon disulfide should be avoided because of its explosive nature. Static electricity is sufficient to ignite the vapors of this gas. Some fumigants have delayed symptoms, and a lethal quantity can be inhaled before any sign can be noticed by the operator. For this reason a small amount of chloropicrin is usually included with methyl bromide to act as a warning agent.

Contact with the skin should be avoided with all fumigants. Besides the possibility of toxicity through skin absorption, most fumigants cause severe burns and skin irritation.

(1) Toxicities of commonly used organic phosphates:

Just how dangerous are some pesticides with low LD_{50} ratings? There is disagreement between experts. Some claim that these chemicals are even more toxic than the following data indicates:

TEPP

Three drops of TEPP (Tetraethy pyrophosphate) concentrate, as you buy it from the supplier, will kill you if taken internally. And three drops on the skin is lethal to the average

sized man. (A small child would be killed by one or two drops on the skin.) Assuming 20 drops to a fluid ounce of chemical, one gallon distributed with maximum efficiency would be enough to kill 853 average sized people!

Phosdrin

Phosdrin, another commonly used and very effective insecticide, will kill an average sized man if he swallows 15 drops or gets 18 drops on his skin.

Parathion

Eighteen drops of parathion taken orally, or 64 drops on the skin is lethal.

How easy it is to spill a fatal dose of any of these concentrates upon yourself or your fellow workers! How important it is not to breathe even the diluted spray of such powerful poisonous chemicals! The high toxicity is understandable when we realize that many of the early organic phosphate insecticides were discovered during World War II research designed to develop nerve gases for chemical warfare. Many of the useful insecticides used today, though not gases, are very closely related to those original compounds.

How Pesticide Chemicals Work in the Body

How do pesticides actually kill a warm-blooded animal? What is the chemistry involved? Answers to these questions may help us to gain a better understanding of how to handle them. In this section, three common groups of chemicals will be discussed--organic phosphates, chlorinated hydrocarbons, and carbamates.

Organic Phosphates

Many of the organic phosphates are very toxic as evidenced by their low LD_{50} ratings. Each one used offers a hazard to the person handling it if its fumes are breathed (if the chemical is ingested, or if the chemical is spilled on the skin). (The latter is the most common cause of pesticide accidents among agriculture workers.) Since most organic phosphates break down into harmless by-products much faster than chlorinated hydrocarbons, the hazard from illegal residue is low. Most of them are also more quickly detoxified (broken down into

harmless chemicals within the body) than the chlorinated hydrocarbons. However, organic phosphates offer a greater hazard to the careless individual handling them because many of them are as toxic when absorbed through the skin as when taken orally, and skin exposure is far more likely than swallowing. Some of the most widely used and highly toxic members of this group are: Parathion, TEPP (tetraethyl pryophosphate), EPN (ethyl p-nitrophenyl thionobenzene phosphorate), Demeton or Systox, Di-Syston, Scradan, Phosdrin, Phorate (Thimet), and Methyl Parathion. These are the most potentially dangerous to the user and the accidentally exposed. The ease with which they are absorbed through the skin emphasizes the need for protective clothing and adequate respirators while working with them.

Much less toxic are Malathion, Chlorthion, Ronnel (Korlan), Diazinon, Dicapthon and Trichlorofon--even though they apparently act in the same manner as the other organic phosphorous compounds. This lower toxicity may be due to slower absorption and other complex factors involved in detoxification within the body.

Organic phosphates cause injury to animals by inhibiting the action of an enzyme called cholinesterase (pronounced coaleen-ESTER-aze). In the process of nerve impulse transmission, very small electrical impulses are transmitted from nerve cell to nerve cell--by the organic chemical acetylcholine (asa-TEEL-coaleen). This gap between the cells is called the synapse (pronounced sin-APS). As soon as the nerve impulse passes the synapse, this chemical is broken down chemically to nonconductors by the enzyme, cholinesterase, resulting in a single nerve impulse. When there is an organic phosphate present, there is not enough cholinesterase present to "break the circuit," resulting in continuing nerve impulses that are detrimental to normal body processes.

Before a person works with organic phosphates, he should have a physician check his blood for its normal level of cholinesterase. This is the base against which to compare later blood tests, When working with organic phosphates the worker should periodically (often once per week) have a blood sample taken to determine the cholinesterase level. When this level goes down to

a critical level, it is an indication that the worker has had dangerous exposure to organic phosphates and should avoid any further exposure until his body has had time to regenerate cholinesterase to its normal level. Usually a commercial applicator will do some other work until a blood sample tests normal. Experience in the field indicates that some individuals are less affected by exposure to organic phosphates than others, although clinical data cannot confirm or explain this difference among individuals. Also, when two people have a similar body chemistry, the person who weighs more will be able to take a larger dose of a given chemical without harm than the smaller person. This is because, as with most chemicals, toxic dosage is proportional to body weight.

Chlorinated Hydrocarbons

Chlorinated hydrocarbons are more dangerous chronically (through their long-lasting stability and their tendency to accumulate in body fat) than they are acutely poisonous. Chlorinated hydrocarbons are long-lived chemicals generally, and present more hazard in causing illegal residue on food crops than personal injury to the person handling the concentrate or spray. However, they can cause death from acute poisoning if a person is exposed to enough of the chemical.

Chlorinated hydrocarbons commonly used as insecticides are: Aldrin, dieldrin, chlordane, DDT, DDD, toxaphene, lindane, heptochlor, methoxychlor, endrin, thiodan, TDE, and perthane. These chemicals act upon the central nervous system and neuromotor apparatus. The exact mechanism of this action, either in man or in animals, has not been explained. Yet it is clear that large doses induce nausea and/or diarrhea. On repeated dosage, the compounds produce microscopic changes in the liver and kidneys in some experimental animals. Somewhat different damage may result from a single fatal dose.

Chlorinated hydrocarbons (and/or certain of their degradation products) getting into the body are stored in fat. Such storage results

either from a single large dose or from repeated small doses. The materials stored in the fat appear to be largely inactive, since the total amount stored in an experimental animal often may be greater than a lethal dose given at one time. Most of these compounds are absorbed through the skin as well as the respiratory system and digestive tract. DDT is not absorbed through the skin unless in solution. Others, such as chlordane and dieldrin, are readily absorbed through the skin.

Carbamates

The carbamate group has come into the pest control picture in the last few years and many experts believe that carbamates will be more important in the future because of their relatively low toxicity and faster break down into harmless by-products on food crops. A common carbamate insecticide now being used as a substitute for DDT in areas where residue is a problem is Sevin.

Sevin is considered to be one of the less hazardous pesticides, yet it too can be dangerous if it is absorbed in large enough amounts through the skin or the respiratory or digestive tracts. Like the organic phosphate compounds, it affects the enzyme cholinesterase, but this action is rapidly reversible.

NOTE: Additional review may be made of the toxicity of insecticides on pp. 131-142 of the U.S.D.A. Yearbook of Agriculture 1956, Animal Diseases.

b) Pesticide residues

In pesticides a residue is the amount of the active chemical in or on a product when it is offered for sale. It is expressed as parts per million (ppm) which is a measure of the amount of the chemical in relation to the total weight of the product sample measured. The residue tendency of a chemical is not the same as its toxicity. The residue tendency is the persistence factor of the chemical, or its tendency to break down slowly or not at all under field conditions. The long-lived chemicals are more of a residue problem than are the short-lived ones. The worst offenders, i.e., the longest lasting in potential danger to humans, are members of the group known as chlorinated

hydrocarbons. These include DDT, endrin, dieldrin, aldrin, BHC, and several others. These chemicals in the dilute forms as they are sprayed on the crops are not highly poisonous in the acute sense, but they do not degrade, i.e., break down into other by-products, rapidly as do the organic phosphates.

A residue in itself is not illegal. When it exceeds a certain pre-established safe level, then it becomes an illegal residue. The Federal Food, Drug, and Cosmetic Act of 1938, and the later Miller Pesticide Chemical Amendment of 1954 require that safe residues must be determined before a chemical can be sold commercially. In other words, food can have some slight traces of pesticides on it or in it and not be harmful to the consumer's health. These safe levels which are established by the Food and Drug Administration are called tolerances.

Animal products intended for food may become contaminated with pesticide chemicals in a number of ways.

(1) Insecticides which persist on feedstuffs are ingested and are either stored in animal tissues or excreted in milk.

(2) Barns, troughs and stables sprayed with DDT and other similar chemicals can contaminate milk supplies even if animals are outside when spraying is done.

(3) Spraying and dipping - contaminants absorbed and stored.

c) <u>Residue Tolerances</u>

Public Law 518 provides for the establishment of tolerances for pesticides chemicals in or on raw agricultural commodities. The term "pesticide chemical" means any substance which alone, in chemical combination, or in formulation with one or more other substances is an economic poison within the meaning of the Federal Insecticide, Fungicide, and Rodenticide Act.

The tolerance of a chemical may vary with different crops and animal products. This is due to its having different effect on the consumer in different foods. For example: a typical tolerance or legal residue is seven parts per million (7 ppm) of DDT on lettuce. This means that seven parts per million of DDT can appear in or on a head of lettuce and it

will still be safe for human consumption. Some pesticides have a zero tolerance. This means that no residue can appear on or in a food. DDT has an affinity for fat and will accumulate in the fatty tissue of mammals and the fat globules in milk. Since milk is fed to babies and they get little other food, food purity is even more important in milk to prevent harmful concentrations of pesticide residue building up in small bodies. So there is a zero tolerance of DDT for milk. The established tolerances imply that seven parts per million of DDT on lettuce is safe, yet any DDT in milk is potentially of cumulative buildup in small bodies (chronic) than one of single-dose danger (acute); yet such a distinction is academic.

Does zero tolerance mean you cannot use a chemical on a crop? No, you may use the chemical on a crop, but the chemical must degrade completely to harmless by-products before it can legally be offered for sale. The grower must allow adequate time for this degradation process to take place, or an illegal residue may result.

Unlisted Tolerances

If there is no tolerance listed for a certain chemical on a certain crop, can you use it? The answer is yes, you may, but until the Food and Drug Administration establishes a tolerance or a legal residue for that particular chemical on that certain food crop, the tolerance is zero. Thus, you can use the pesticide, but there must be no trace of it left on the food product when you put it in the market. Obviously the risk of loss here is great unless you are using a product which for other similar foods has a known quick dissipation of residue. You can get information about official tolerances that have been established for each tested chemical on certain crops from the Food and Drug Administration itself or from your County Agriculture and Products Commissioner.

When the Food and Drug Administration established these tolerances, it built in safety factors, much as an engineer designs a bridge with many times the strength it will ever be expected to need. The FDA scientists may be quite sure that a certain chemical will be safe for man at five hundred parts per million--because larger doses begin to adversely affect small test animals such as rats or rabbits. However, these scientists, knowing that animal

experiments do not always indicate similar reactions in man, will, to be on the safe side, set the tolerance at one one-hundredth (.01) of that figure--five parts per million. The desirability of this approach is apparent when you consider they are establishing these tolerances for a wide range of conditions and individual differences, many of which cannot be foreseen or predicted. Other safety factors include the determining of degradation rates and human detoxification capabilities, and the FDA's authority to inspect raw agricultural crops wherever located, plus the right to confiscate and destroy products that carry illegal residues.

Tolerance Safety Factor

Because of these safety factors the chance of poisoning a consumer is very remote if you follow the label and apply the pesticide in the manner, amounts, and timing prescribed. To repeat: There has never been a proven case of a person being killed by foodstuffs that had been treated by a pesticide applied according to label instructions.

d) Labels

A pesticide's label has been called the most expensive piece of literature in existence. Chemical companies estimate that it costs them one and one-half to three million dollars before they can register a new chemical and put it on the market. The main reason for this expense is the extensive and exhaustive tests that the manufacturers must conduct to satisfy governmental agencies on the chemical's usefulness and its effects on warm-blooded animals.

(1) The earliest attempt to regulate pesticides was the Insecticide Act of 1910. In 1938 the the Federal Food, Drug, and Cosmetic Act put additional restrictions on agricultural chemicals. This law dealt with food purity and was in the area of the Food and Drug Administration's responsibility. In 1947 the United States Federal Insecticide, Fungicide, and Rodenticide Act came into being, decreeing that "no pesticide may move in interstate commerce until it has the label approval and is registered by the United States Department of Agriculture."

(2) Chemical manufacturing companies must prove a chemical's effectiveness and its exact degree of harmful effects on specified mammals and plants. If it is harmful to organisms other than target pests, it must require safe application formulations and have precautionary statements on the labels. In 1954 the Miller Pesticide Chemical Amendment to the 1938 law came into being. This was a law dealing with food purity and was again in the area of the Food and Drug Administration's responsibility. It set up certain legal residues that would not be harmful if eaten by the consuming public. Since 1954 there have been other public laws and amendments put into effect which refined these regulations.

(3) Recently Public Law 88-305 has stipulated that the number of the registration must appear on the pesticide's label. Anyone dealing with pesticide safety must remember that the pesticide label is probably the most important piece of information that he has to work with. The law requires that a legible label appear on every container of a harmful chemical and that certain important information be included thereon. The label is really a boiled-down version of the registration data that must be approved by the USDA before the company can legally sell the product in interstate commerce. The label must include:

-- The manufacturer

-- The correct chemical name of the material

-- The per cent of active ingredients

-- The safety precautions when using this material

-- Approved uses

-- Timing of application to avoid illegal residue

-- Warning to the user about its toxicity

-- Any other pertinent information that would apply in the use of this particular chemical

(4) If you observe a label closely--and you should do so with every pesticide you deal with--you will be able to pick out these individual sections. Every handler of a pesticide should become thoroughly familiar with its label and urge everyone who uses this hazardous material to read the label twice before each using and to believe what it says.

(5) Regulations put into effect by the United States Department of Agriculture in March, 1964, state that warnings must appear in a prominent place on the label. In the past, very toxic materials had a small red skull and cross bones in the corner of the label. Now this warning must appear in the center and in a very prominent place. If the chemical is dangerous, the word "Danger" "Caution," or "Warning" must appear on the label along with the statement, "Keep out of the reach of children." The company cannot use the words "safe" or "non-poisonous" on labels for these materials because these words are misleading. All pesticides are poisonous to some degree. An example of this is malathion which in normal amounts is almost non-poisonous and is relatively safe; but to state that it is safe or non-poisonous would be misleading to the uninformed, so these words cannot appear on the label. The governmental agencies involved are: (1) The United States Department of Agriculture, which is responsible for registering all pesticides and checking the registration information from the company before it will allow the company to sell the material in interstate commerce; and (2) The Food and Drug Administration which is responsible for establishing the safe levels of pesticide residue for food crops consumed by the public. The FDA also checks daily upon food samples collected in food markets and distribution centers to make sure that these safe residue levels are met.

(6) In other words, the USDA deals with checking a new pesticide's performance and safety data before it can be registered and sold, and the FDA is charged with the responsibility of food purity when the food is offered for sale to the consuming public. In spite of the problems these regulations may cause growers, they should welcome this kind of scientific protection against mass food poisoning to prevent the grief which might follow if these precautions were not taken.

c. Food and Feed Laws and Regulations

1) The Federal Food, Drug, and Cosmetic Act prohibits the introduction or delivery for introduction into interstate commerce of any food, drug, device, or cosmetic that is adulterated or misbranded, the receipt of any such food, drug, device, or cosmetic in interstate commerce, and the adulteration or misbranding of any food, drug, device, or cosmetic while in interstate commerce. "Food" is defined as any article used for food or drink for man or other animals.

a) Adulteration

b) Misbranded

See pp. 97-98, Law for the Veterinarian and Livestock Owner - Hannah and Storm

2) The Federal Food, Drug, and Cosmetic Act is supplemented by a number of federal laws which have as their major focus:

a) Meat

b) Meat and meat food products

c) Meat and meat products

d) Inspection of agricultural products

e) Sanitary inspection

f) Inspection of animals for export

g) Transportation of diseased animals

h) Prevention of contagion among animals

i) Meat and meat animals for export

j) Suspension if importation

d. Animal Disease Laws

1) Common law liability - liability which is charged under ordinary rules of negligence.

2) Responsibility for disease control

a) U.S.D.A. - administration of meat inspection, disease eradication, animal inspection, and quarantine functions.

b) Import - Export laws

c) Meat and animal foods inspection

d) General animal disease control

e) Animals in transit

3) State and local animal disease laws

a) State department of agriculture or its equivalent

-- General animal disease control in the state

-- Testing and destruction

-- Sale for slaughter

-- Quarantine

-- Entry of animals from outside of the State

-- Community sales

-- Dead animal disposal

NOTE: Pages 62-70 of Animal Diseases 1956 Yearbook of Agriculture has comprehensive statement on quarantine of farm animals.

e. State Feed Laws

Legislation on commercial feeding stuffs has two aims: to require labeling of a kind which will enable the buyer to determine its composition, and to require a statement of net weight of contents. A typical provision on labeling requires that the tag or other label shall certify the minimum per cent of crude protein, the minimum per cent of crude fat, and the maximum per cent of crude fibre. Reference may be made to the methods adopted by the Association of Official Agricultural Chemists of the United States for determining these percentages. Whole grains, unmixed meals, hay, hulls, stalks, and straw are excluded from the definition of feeding stuffs. A statement of mineral content may be required, together with the specific name of each ingredient used. State Departments of Agriculture are required to take samples, make tests and take action against any feed manufacturer who is not complying with the law. Penalities for violation are customarily provided.

f. Example of governmental functions in pesticide use in one state - California

1) USDA requires that all pesticides be properly registered and labeled.

2) USDA establishes precautions for safe use of pesticides and checks them for their usefulness.

3) FDA establishes tolerance levels for pesticide residue in foods and enforces adherence to them.

4) California Department of Agriculture cooperates with USDA and FDA in registering and regulating, sampling, testing, and enforcing regulations.

5) California Department of Agriculture establishes standards and procedures for licensing pest control operators and ag pilots.

6) California Department of Agriculture investigates accidents and damages and then files complaints against users who do not comply with regulations.

7) California Division of Industrial Safety watches out for any conditions hazardous to workers. CDIS can file complaints against employers.

8) County Agricultural Commissioner assists in enforcing all agricultural regulations dealing with pesticides on county level.

9) County Agricultural Commissioner tests and licenses pest control operators.

10) County Agricultural Commissioner issues permits to growers for purchase and use of pesticides, and keeps records of their use.

2. The safe use of chemicals in the field of animal health

a. Major concerns

1) The difference between <u>hazard</u> and <u>toxicity</u>

a) hazards

b) toxicities

2) Incompatibilities

3) Transporting and storing

4) Applying or administering safely

5) Care of equipment and use of equipment

6) First aid

a) Symptoms of poisoning

b) Action to take

7) Responsibility and liability for use

8) Prevention of accidents when handling pesticides

9) Protective clothing and devices

10) How to mix chemicals safely

11) Disposal of empty containers

12) General "Do's" and "Don'ts" of pesticide safety

Suggested Teaching-Learning Activities

1. Invite the County Agricultural Commissioner or his representative (or representative of similar agency) to speak to the class on the lawful and safe use of chemicals to maintain farm animal health.

2. Have each member of the class secure copies of various legislative acts and regulations which pertain to the manufacture, sale, and use of insecticides and other pesticides used in the maintenance of farm animal health.

3. Plan and conduct a farm chemicals safety program for your community.

4. Assemble a safety demonstration kit and sponsor workshops and field days for interested groups of your community.

5. Examine labels, tags, and other commercial printed materials regarding the safe and lawful use of various chemicals used to maintain farm animal health.

Suggested Instructional Material and References

Animal Diseases, U.S.D.A. Yearbook of Agriculture, Superintendent of Documents, Washington, D.C., 1956.

Hannah, H. W., and Storm, D. F., Law for the Veterinarian and Livestock Owner, The Interstate Printers and Publishers, Inc., 1959.

Pesticide Manual, 1965 North Carolina Handbook, Division of General Extension, Raleigh, North Carolina, 1965.

Agricultural Chemical Safety, Teachers Handbook, California State Polytechnic College, San Luis Obispo, California, 1966. ($3.50 - order from El Corral Bookstore)

Agricultural Chemical Safety, Student Workbook, California State Polytechnic College, San Luis Obispo, California, 1966. ($.50 - order from El Corral Bookstore)

Federal Acts:

Federal Food, Drug and Cosmetic Act (and Amendments)

Federal Insecticide, Fungicide, and Rodenticide Act (and Amendments)

Copies of State and Local Regulations.

Hays, V. W., Antibiotics in Swine Rations, Elanco Products Company, Indianapolis, Indiana.

THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT
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THE OHIO STATE UNIVERSITY
980 KINNEAR ROAD
COLUMBUS, OHIO, 43212

INSTRUCTOR NOTE: As soon as you have completed teaching each module, please record your reaction on this form and return to the above address.

1. Instructor's Name_____

2. Name of school_____State_____

3. Course outline used: _____Agriculture Supply--Sales and Service Occupations
   _____Ornamental Horticulture--Service Occupations
   _____Agricultural Machinery--Service Occupations

4. Name of module evaluated in this report_____

5. To what group (age and/or class description) was this material presented?____
   _____

6. How many students:
   a) Were enrolled in class (total) _____
   b) Participated in studying this module _____
   c) Participated in a related occupational work experience program while you taught this module _____

7. Actual time spent teaching module:

		Recommended time if you were to teach the module again:
_____hours	Classroom Instruction	_____hours
_____hours	Laboratory Experience	_____hours
_____hours	Occupational Experience (Average time for each student participating)	_____hours
_____hours	Total time	_____hours

(RESPOND TO THE FOLLOWING STATEMENTS WITH A CHECK (✓) ALONG THE LINE TO INDICATE YOUR BEST ESTIMATE.)

	VERY APPROPRIATE	NOT APPROPRIATE
8. The suggested time allotments given with this module were:		
9. The suggestions for introducing this module were:		
10. The suggested competencies to be developed were:		
11. For your particular class situation, the level of subject matter content was:		
12. The Suggested Teaching-Learning Activities were:		
13. The Suggested Instructional Materials and References were:		
14. The Suggested Occupational Experiences were:		

(OVER)

15. Was the subject matter content sufficiently detailed to enable you to develop the desired degree of competency in the student? Yes_____No_____
Comments:

16. Was the subject matter content directly related to the type of occupational experience the student received? Yes_____No_____
Comments:

17. List any subject matter items which should be added or deleted:

18. List any additional instructional materials and references which you used or think appropriate:

19. List any additional Teaching-Learning Activities which you feel were particularly successful:

20. List any additional Occupational Work Experiences you used or feel appropriate:

21. What do you see as the major strength of this module?

22. What do you see as the major weakness of this module?

23. Other comments concerning this module:

_____ _____
(Date) (Instructor's Signature)

_____
(School Address)